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The Mongol Empire – the first 'gunpowder empire'?

STEPHEN G. HAW

Abstract

This article uses Chinese sources to argue that a range of gunpowder weapons was already in use in China during the late tenth and early eleventh centuries, earlier than previously thought. 'True firearms', that is cannon or guns firing solid projectiles, had quite probably been developed by at least as early as 1200 CE.

It is now commonly accepted that the Chinese were very probably the first to produce gunpowder, although the precise chronology of its invention remains controversial. Even more contentious is the question of its use in military technology. One hundred and fifty years ago, Sir John Francis Davis, one of the first British governors of Hong Kong, suggested that "its particular application to firearms was probably derived from the west." It "was probably applied by them [the Chinese] to fireworks ... or other harmless and useful purposes, long before their unwarlike spirit could have suggested the use of guns ...".[1] Such beliefs persisted for a long time and still have their place today in the popular imagination. During the past thirty years or so, scholars in both China and the West have produced more reasonable assessments of the Chinese use of gunpowder in weaponry, but the exact dating of various technical developments has remained unclear and often disputed. My own researches have shown that, in many cases, the dates heretofore proposed for the earliest use of various kinds of gunpowder weapons are frequently too recent. It will be shown here that a range of gunpowder weapons was already in use in China during the late tenth and early eleventh centuries, and that 'true firearms', that is cannon or guns firing solid projectiles, had quite probably been developed by at least as early as about 1200. It must always be borne in mind that "many, if not most, early gunpowder weapons were meant to function as incendiaries, not as bombs or guns".[2] The earliest Chinese gunpowder weapons were certainly incendiary rather than explosive. In fact, incendiary weapons were probably often more effective than explosive bombs, as they could cause large conflagrations in urban areas. They were almost always more effective than guns firing solid shot. It must therefore be understood that incendiary gunpowder was the essential precursor of explosive gunpowder. Although it

[1] J. F. Davis *China: a General Description of that Empire and its Inhabitants*, new edn (London, 1857), ii, p. 181.
[2] B. S. Hall "Introduction, 1999", in *A History of Greek Fire and Gunpowder*, J. R. Partington, new edn, (Baltimore and London, 1999), p. xvii.

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has been said that: "the historian cannot make a clear distinction between explosives and incendiaries",[3] I shall attempt to do so here.

A fundamental problem with interpreting Chinese literary evidence relating to gunpowder weapons is that many terms were used ambiguously. For example, '*huojian*' may mean either 'fire-arrows' or 'rockets': the former may have been gunpowder weapons, fired from bows or crossbows but using gunpowder in the incendiary mixture that they delivered, or they may have carried incendiary substances containing no gunpowder. Rockets were, of course, certainly gunpowder weapons.[4] '*Huopao*' may mean a catapult firing an incendiary or explosive bomb, it may mean the bomb itself, or it may mean a cannon or gun. Incendiary bombs may or may not have contained gunpowder. Thus, references in literature must be interpreted with extreme caution. Usually, it is only if the weapon is actually described, rather than merely named, that there can be any certainty about exactly what kind of weapon it was. Unfortunately, detailed descriptions of weaponry are rather rare in Chinese literature, at least before the period of the Ming dynasty.

There is one kind of weapon, however, which appears not to suffer from this kind of ambiguity (at least until after the fourteenth century). This is the fire-lance or '*huoqiang*'. Although references to it in literature of the tenth to thirteenth centuries are quite scarce, it is described in reasonable detail more than once. It is important as it was almost certainly the direct precursor of true firearms. Some of the early descriptions of this weapon have often been quoted, but are worth repeating here. The earliest is in an account of the siege of De'an (modern Anlu in Hubei province) in 1132, during fighting between the Jin and Song empires. Under the leadership of Chen Gui, the defenders of the town "used gunpowder [*huopaoyao*] to make more than twenty long bamboo fire-lances".[5] In Chen's biography in the *History of the Song Dynasty*, the use of these fire-lances is recorded: "Gui with sixty men carrying fire-lances went out of the west gate" and destroyed the siege engines of the attackers.[6] More detail of the construction of fire-lances is given in later works. According to the *History of the Jin Dynasty*, in 1233 fire-lances were used in fighting between Jin forces and the Mongol armies. Their construction and use are described as follows:

> To make the lances, sixteen sheets of imperial yellow paper were made into a tube some two feet [*chi*] long, which was filled with willow charcoal, iron filings, fragments of pottery, sulphur, arsenic and suchlike things, and bound to one end of the lance with cord. Each soldier carried a small iron pot containing fire, to light [the lance] when near the scene of battle. Flames shot out in front of the lance to a distance of more than ten feet. When the powder was finished the tube was not destroyed. They were used when Bianjing [Kaifeng] was attacked and were again used now.[7]

Bianjing had become the principal capital of the Jin empire in 1214, after Zhongdu (modern Beijing) had come under repeated attack by Mongol forces. The Mongols began a long siege of Bianjing in April 1232. During the following winter, the Jin emperor fled the city, which

[3] *Ibid.*, p. xviii.

[4] On the development of rockets in China, see S. G. Haw, "Cathayan Arrows and Meteors", *Journal of Chinese Military History* II (2013), pp. 28–42.

[5] Tang Shu, *De'an shou yu lu* [*DSL*], xia juan, p. 55.

[6] Tuotuo & Ouyang Xuan, *Song Shi* [*SS*], xxxiii, juan 377 [liezhuan 136], p. 11643.

[7] Tuotuo & Ouyang Xuan, *Jin Shi* [*JS*], viii, juan 116 [liezhuan 54], p. 2548.

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capitulated in May 1233. The use of fire-lances at Bianjing is recorded in an account of the siege in the *History of the Jin Dynasty*.[8]

Another description of fire-lances says that, in 1259, Song military forces made "shooting fire-lances [*tuhuoqiang*]", which "used large bamboo for tubes, into which charges of shot [*zike*] were put. When they were lit, they spouted flames and then fired the shot, like cannon. Their noise could be heard far away, at a distance of more than 150 paces [*bu*]".[9] It is not clear whether each fire-lance fired just one charge of shot or several, nor exactly what the shot were. Obviously, however, this kind of fire-lance was somewhere between the basic, flame-throwing fire-lance and the gun. It should also be noted that, if my interpretation of this passage is correct, then cannon already existed at this time. I shall return to this question below.

What is probably the earliest evidence of the existence and use of the fire-lance is not in any text but in a painting that was among the material collected at Dunhuang by Paul Pelliot. Now in the Musée Guimet in Paris, it depicts the assault of Mara on the Buddha. Among the various demons surrounding the seated Buddha is one grasping what is clearly a fire-lance. The demon holds the lance horizontally. At one end of the pole is a tube from which flames are spurting, also horizontally. This painting has been dated to about 950.[10] It has been doubted whether the fire-lance could have existed so early,[11] but the painting certainly depicts a fire-lance, and the dating is very unlikely to be far wrong. The material which the Pelliot Mission brought to Paris from Dunhuang came from the hoard of materials (manuscripts, printed documents, paintings, banners etc.) in Cave 17, the so-called 'Library Cave', which was most probably sealed in the early eleventh century. No dated document from the cave is later than 996[12] except possibly for one, which may date from the eleventh century.[13] Although forged documents supposedly from Dunhuang undoubtedly exist and the exact date at which the cave was sealed is not entirely certain, the Pelliot collection seems to be above all suspicion,[14] and there is little likelihood that any genuine Dunhuang material dates from later than about 1035. It seems very likely that the hoard was sealed into its hiding place when Dunhuang was conquered by the Tanguts of the Xi Xia state in 1036.[15]

This pictorial evidence for the early existence of the fire-lance is therefore highly significant. It is supported by a literary reference to fire-lances that seems to have gone unnoticed until now (since writing this, however, I have found that Schlegel referred to it

[8] *JS*, vii, juan 113 [liezhuan 51], p. 2497.

[9] *SS*, xiv, juan 197 [zhi 150], p. 4923. It should be noted that modern editions of the *Song Shi* often punctuate this passage wrongly, and also that the last five characters translated here ["*bai wushi yu bu*"] have very likely been transposed at some time with the previous three ["*sheng yuan wen*"], so that the passage probably should read: "... like cannon, to a distance of more than 150 paces. Their noise could be heard far away." 150 paces is not very far for noise to carry.

[10] This painting is reproduced in colour in L. Hambis (ed.) *Bannières et Peintures de Touen-Houang conservées au Musée Guimet: planches*, (Paris, 1976), p. 5.

[11] Liu Xu, *Zhongguo gudai huoyao huoqi shi* (Zhengzhou, 2004), p. 27.

[12] T. F. Carter, *The Invention of Printing in China and its spread westward*, 2nd edn, revised by L. C. Goodrich, (New York, 1955), pp. 55, 62–63n.

[13] S. Whitfield, *The Question of Forgeries: introduction to a collection of papers from the 1998 Conference at the British Library*. Online. Available HTTP: http://idp.bl.uk/papers/forgeries.html (accessed 22 May 2006).

[14] *Ibid.*

[15] P. Pelliot, "Une bibliothèque médiévale retrouvée au Kan-sou", *Bulletin de l'Ecole Française d'Extrême Orient*, 8 (1908), p. 506; Chen Bingying, "Shiyi Shiji Cunzaiguo Tongzhi Gua Sha Er Zhoude Huihu Hanguo ma?", *Dunhuang Yanjiu*, 68(2) (2001), p.72.

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as long ago as 1902, but he seems to have used a defective version of the text and certainly interpreted it wrongly.[16] Indeed, the whole of his interesting article is full of errors). This record states that in the year 1000, Tang Fu, commander of the Shen Wei Marines [*shuijun*], presented to the throne "newly-made fire-arrows, fire-bombs, and fire-lances".[17] This same event is also recorded in the *History of the Song Dynasty*, but without mention of fire-lances.[18] However, the *History* is a later source and it must be probable that Tang Fu presented a number of different weapons, not all of which are mentioned in either of these two works. It is therefore reasonable to accept that fire-lances were in use in the Song Empire by no later than 1000, and that they were also known in the area of Dunhuang at about the same period. Dunhuang became part of the Tangut Xi Xia state shortly after this time. There is further evidence of the existence of fire-lances not long after the year 1000 in the famous *Wu Jing Zong Yao*, completed in about 1044. Although there is no detailed description of fire-lances in this work, they are mentioned briefly among weapons suitable for the defence of a walled town.[19] It should be noted also that the association of fire-arrows and fire-bombs with fire-lances among the "newly-made" weapons presented by Tang Fu suggests that they all used similar technology, that is, that they were all gunpowder-based incendiary weapons.

The early date of the fire-lance is important because this weapon, a tube filled with gunpowder which ejected flames and sometimes also solid projectiles (even if only very small ones, such as iron filings and fragments of pottery), was a direct precursor of the true gun. It was only necessary to use a stronger tube, containing more or less explosive gunpowder and firing a single projectile (or charge of projectiles, like a shotgun), and the fire-lance became a gun. The Chinese at this period already had the necessary foundry skills to cast strong metal tubes. They had, of course, been making large, complex objects in bronze for considerably more than two thousand years by this period, and had known how to cast iron for well over a millennium. Surviving large cast-iron objects from the period of the Song dynasty, such as the iron pagoda at Jining in Shandong dating from 1105,[20] testify to their skills in working with molten iron. Once they had developed explosive gunpowder, containing a higher proportion of saltpetre (potassium nitrate) than the incendiary mixtures used in their early gunpowder weapons, then they had everything necessary to make guns. It should also be noted here that the ability to make fire-lances implies the ability to make rockets, too. It is only necessary to reverse the tube containing more or less the same mixture as a fire-lance and attach it to a thinner and lighter shaft, and the result is a rocket. Exactly when '*huojian*' came to mean 'rocket' as well as 'fire-arrow' remains very uncertain, however.

The fire-lance continued to be used in China for several centuries. It is mentioned in a number of works from the period of the Ming dynasty. A work of the mid-sixteenth century says:

> The pear-flower lance is a tube of pear-flower [presumably a gunpowder mixture including something which produced white sparks like pear flowers] fastened to the end of a long lance. It

[16] G. Schlegel "On the invention and use of fire-arms and gunpowder in China, prior to the arrival of Europeans", *T'oung Pao*, series II, 3 (1902), pp. 5–6.

[17] Zhang Ruyu, *Qun Shu Kao Suo* [*QSKS*], ii, hou ji, juan 43, p. 704.

[18] *SS*, xiv, juan 197 [zhi 150], p. 4910.

[19] Zeng Gongliang, Ding Du *et al.* (eds.), *Wu Jing Zong Yao* [*WJZY*], qian ji, juan 12, p. 58.

[20] S. G. Haw, *Marco Polo's China: a Venetian in the realm of Khubilai Khan*, (London and New York, 2006), p. 112.

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> is used when close to the enemy. When it is fired it has a range of several *zhang* [tens of feet] and any man touched by its discharge will die. When the fire is used up, the lance can still stab the enemy, so it is the first [i.e. most important] frontline fire weapon. During the Song dynasty, Li Quan was already using them.[21]

It seems likely that this kind of fire-lance contained poison, which was why "any man touched by its discharge will die." Fire-lances were apparently still being made in China during the first half of the twentieth century.[22]

Before discussing the period at which the Chinese first made cannon, other early kinds of gunpowder weapons apart from the fire-lance should be considered. Tang Fu's array of weapons, all probably similar in kind, included not only fire-lances but also fire-arrows, fire-bombs and something called '*huo jili*'.[23] This weapon is described and illustrated in the *Wu Jing Zong Yao*. It was a kind of grenade, consisting of a ball of incendiary mixture (including non-explosive gunpowder) with metal spikes sticking out all around.[24] It should be pointed out here that the illustrations in the *Wu Jing Zong Yao* are certainly not original. As far as I am aware, no original, or early Song, edition of this book is still extant today. The existing illustrations have been copied (probably more than once) from one edition to another of the work. It appears that they may often have been altered and at least some must have been added at a date long after the original completion of the book. A number of them lack any accompanying text and in at least a few cases the illustration does not match the description in the text. For example, in the *Si Ku Quan Shu* edition of the work, the illustration of a '*shou pao*' clearly depicts a small cannon mounted on the end of a pole, but the text describes a kind of light catapult or sling.[25] Two quite large cannon are depicted,[26] with no accompanying text. These illustrations must undoubtedly have been added long after the 1040s. It must therefore be realised that reproducing illustrations from this work in modern publications may sometimes be misleading.

No doubt the '*huo jili*' was an effective weapon for use at short range against compact bodies of troops, and perhaps especially against siege engines made of wood. At longer ranges, fire-arrows that delivered an incendiary mixture including saltpetre would certainly have been highly effective against wooden structures, including buildings and ships. Bombs carrying a larger quantity of incendiary mixture than could be delivered with an arrow would have been even more effective, although it must have been more difficult to deliver them accurately to their target. Catapults capable of throwing fire-bombs to a considerable distance were in use in China by the mid-eleventh century.[27]

The descriptions of various kinds of incendiary bombs (including those that produced poisonous fumes), and the formulae for gunpowder included in the *Wu Jing Zong Yao* are very well-known and it is unnecessary to reproduce them here. It is perhaps worth noting in passing that the poisonous bombs described would have produced highly toxic smoke. They

[21] Zheng Ruozeng, *Chou Hai Tu Bian* [*CHTB*], p. 949.
[22] J. Needham, *Science and Civilisation in China*, vol 5, part 7, *Military Technology: The Gunpowder Epic*, (Cambridge, 1986), p. 258.
[23] According to *SS*, xiv, juan 197 [zhi 150], p. 4910.
[24] *WJZY*, qian ji, juan 12, pp. 65–66.
[25] *Ibid.*, juan 12, pp. 51–52.
[26] *Ibid.*, juan 10, p. 36. These illustrations are absent from the Ming text (see Bibliography).
[27] *Ibid.*, juan 12, pp. 57, 59.

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contained such things as '*cao wutou*', '*ba dou*' and '*lang du*'.[28] '*Cao wutou*' is various species of *Aconitum*, highly poisonous plants.[29] '*Ba dou*' is usually *Croton tiglium* and is also very poisonous.[30] The name '*lang du*' actually means 'wolf poison'. It is derived from the plants *Euphorbia ebracteolata* or *E. fischeriana*, and again is poisonous.[31] None of the gunpowder mixtures described in the *Wu Jing Zong Yao* contained more than about 50% saltpetre, insufficient for them to be explosive. An explosive bomb, called '*pili huo qiu*', is described in the *Wu Jing Zong Yao*. It used a length of bamboo with unbroken joints, wrapped with an incendiary compound, so that the bamboo exploded when heated by the burning mixture.[32] This would not, of course, have produced as powerful an explosion as could be obtained using true, explosive gunpowder, containing about 75% saltpetre. This kind of bomb was intended for use in enclosed spaces, when tunnelling to counter the mines of besieging forces. In a tunnel the explosion would no doubt have been more effective than in the open air. The gunpowder used in fire-lances, however, very probably contained rather more than 50% saltpetre, and it can only have been a matter of time before it was discovered that adding a higher proportion of saltpetre produced a mixture that burned with explosive suddenness. The range of weapons using some kind of gunpowder mixture, known from the texts mentioned above to have existed by about 1000, shows that the Chinese were very inventive with regard to weaponry and suggests that they would not long have overlooked the potential of gunpowder with a higher proportion of saltpetre.

In 1161, armed forces of the Jin Empire invaded the Southern Song Empire, after almost twenty years of peace between the two hostile states. In late November of that year, part of the invasion force attempted to cross the Yangtze River at a place called Caishi (in eastern Anhui province).[33] Song warships, apparently driven by treadmill-operated paddle-wheels, made a surprise attack while the Jin forces were in boats on the river. According to a contemporary Song account:

> Our ships lay hidden behind Seven Treasures Mountain [an island]. The order was given: "When the flag is raised, then go out onto the River". First, a rider was sent up to the summit of the mountain, holding a flag low. He watched until they were halfway across, then suddenly lifted the flag up high. The fleet came out from behind the mountain into the middle of the River. On both sides, they sped out onto the Yangtze. Men in the ships worked machinery with their feet to make them move: although the boats seemed to fly along, no men could be seen. The foe thought that they were paper boats! Suddenly one of the ships fired a bomb ['*pili pao*']. It was made of paper stuffed with lime and sulphur. The bomb fell from the sky into the water. When the sulphur hit the water, it burst into flame. It leapt from the water with a sound like thunder. The paper burst and the lime was scattered in a cloud of smoke, blinding the eyes of their men and horses. No one could see anything. Our ships sped to the attack. The men and horses in the enemy's boats were all drowned. So they were totally defeated.[34]

[28] *Ibid.*, juan 11, p. 28.
[29] Zhongguo Yixue Kexueyuan Yaowu Yanjiusuo *et al.* (eds), *Zhong Yao Zhi*, i, (Beijing,1959), pp. 128, 131.
[30] Zhongguo Yixue Kexueyuan Yaowu Yanjiusuo *et al.* (eds), *Zhong Yao Zhi*, iii, (Beijing, 1960), pp. 271, 276.
[31] Zhongguo Yixue Kexueyuan Yaowu Yanjiusuo *et al.* (eds), *Zhong Yao Zhi*, ii, (Beijing, 1981), pp. 12, 17.
[32] *WJZY*, qian ji, juan 12, p. 70.
[33] H. Franke and D. Twitchett (eds), *The Cambridge History of China*, vol. 6, *Alien regimes and border states, 907–1368*, (Cambridge, 1994), p. 242; Yang Wanli, *Yang Wanli Ji Jianjiao*, (ed.) Xin Gengru [*YWLJ*], v, pp. 2287–2289.
[34] *YWLJ*, v, p. 2286; Yang Wanli, *Cheng Zhai Ji* [*CZJ*], juan 44, pp. 49–50.

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It has been suggested that this '*pili pao*' was a rocket,[35] but there is in fact no good reason to think that this was so. It seems very much more likely that it was a bomb flung from a catapult. Unfortunately, as is so often the case, the description of the bomb is neither very detailed nor very accurate. It cannot have been the case that it contained only sulphur and lime. Nor can it have burst into flame as a result of the sulphur coming into contact with water, as is implied. This highlights a recurrent problem with Chinese records: they were usually written by literary men with little technical knowledge. In this case, the author, Yang Wanli, is best known as a poet, although he also served in the Southern Song bureaucracy, both in local and central government posts.[36] Clearly, as it exploded "with a sound like thunder", the bomb must have contained not only sulphur but also charcoal and saltpetre; that is, gunpowder. The lime was presumably quicklime. The bomb must have had a fuse, lit before it was thrown from the catapult, which burned for long enough for the bomb not to explode until after it had hit the water. The explosion was clearly sufficiently powerful to scatter the lime into a widespread cloud. Presumably the Song forces must have allowed the lime to disperse and settle before they rushed into the attack, otherwise they also would have suffered from its effects. The bomb must have been made shortly before it was used, for quicklime is strongly hygroscopic and would soon have absorbed moisture, making the bomb damp and probably useless.

It is absolutely clear that the gunpowder used in this bomb contained sufficient saltpetre to explode, rather than just burn fiercely. The noise of the explosion and the fact that the lime was widely dispersed in a cloud make this certain. Thus, by no later than 1161, the Chinese were making fully explosive gunpowder, and were using it for military purposes. However, bombs similar to the one used at Caishi were apparently being made and used even earlier. Lu You (1125–1209) records that:

> The various brigands of Ding Li [near the Dongting Lake in modern Hunan province], such as Zhong Xiang and Yang Yao, had fighting vessels including paddlewheel ships ... and weapons ... that soldiers armed with normal swords and spears could not withstand. So the government army made lime bombs. They used easily-shattered pottery containers and filled them with poison, lime and iron caltrops. When they went into battle they attacked the brigands' ships with them, the lime flew like smoke and fog and the brigands' troops could not open their eyes.[37]

This refers to a period in the early 1130s. Yang Yao rose in rebellion in 1133 and was defeated in 1135.[38] Although there is no mention of gunpowder in this account, there would have been no point in putting iron caltrops in the containers without explosive gunpowder – they were shrapnel, to wound and kill when the bombs exploded. The fact that "'the lime flew like smoke and fog'" also suggests explosion. It therefore seems that bombs similar to that used at Caishi in 1161 already existed by no later than 1135. It is interesting that these early bombs had pottery casings. Pottery bombs continued to be made and used at least until the late 1200s. Some have been found by archaeologists investigating the remains of ships which

[35] Liu Xu, *Zhongguo gudai huoyao huoqi shi*, (Zhengzhou, 2004), pp. 35–36.
[36] Nanjing University, History Department (ed.), *Zhongguo Lidai Mingren Cidian*, (Nanchang, 1982), p. 282.
[37] Lu You, *Lao Xue An Biji* [*LXABJ*], juan 1, pp. 1–2.
[38] *SS*, xxxiii, juan 365 [liezhuan 124], pp. 11381–11385.

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sank off the coast of Japan during the attempted Mongol invasions of 1274 and 1281. At least one contained pieces of metal shrapnel.[39] There can therefore now be no doubt that such bombs were made and used by Yuan forces no later than 1281. An exploding bomb is depicted in the famous invasion scroll of Takezaki Suenaga.[40] The hypothesis that this bomb was a later addition to the scroll can be firmly rejected on the basis of the archaeological evidence.

Explosive gunpowder was very probably in use even before the 1130s. An account of the Northern Song capital, Bianjing (Kaifeng), written by someone who was resident there for more than 20 years until it fell to the Jurchens in 1127, describes a military display that was an annual event in the city in spring. Various pyrotechnical effects were used during the performance, including a number of loud explosions produced by '*baozhang*'.[41] '*Baozhang*' were firecrackers which used gunpowder. Earlier, such bangs had been produced by heating bamboo: firecrackers of this kind were called '*baozhu*'.[42] Although heating bamboo would produce a very loud bang, the timing of the explosion would have been difficult to control. This would have been unhelpful during a display, when timing was important. These '*baozhang*' may well have been made of tubes of rolled paper. A slightly later record, from about 1150, refers to "small boys letting off paper bangers [*zhipao*]".[43] It would seem that, by the middle of the twelfth century, explosive gunpowder was sufficiently common and familiar to have become a plaything for children. Rather earlier, however, gunpowder had already become so important to the Song state that trade in its major ingredients was controlled. The *History of the Song Dynasty* records that, in 1076, private cross-border trade in sulphur and saltpetre was forbidden.[44] This certainly suggests that gunpowder was of strategic significance by that time. It also indicates that the Liao Empire was importing sulphur and saltpetre, until the ban was imposed. No doubt the Liao armies were also using gunpowder weapons by this date.

The association of gunpowder firecrackers with a military display in Kaifeng in the 1120s suggests that the Song armed forces were probably using explosive gunpowder for military purposes by then. Further evidence of this is an eye-witness record that, when Kaifeng was besieged by Jin forces in 1126, explosive bombs ('*pili pao*') were fired from the city at the attackers at night.[45] There is no description of exactly what these bombs were like, so it is impossible to be absolutely certain that they contained explosive gunpowder. However, the name is exactly the same as that applied to the bomb used at Caishi in 1161. Since it seems that the Song armed forces were using explosive gunpowder in firecrackers during military displays during the 1120s, and that bombs were in use during the 1130s, then it must be probable that these '*pili pao*' of 1126 were similar to the one used at Caishi some 35 years later (although perhaps without the lime). Thus, it is highly likely that exploding gunpowder bombs were already being used by Song forces as early as 1126. If similar technology was not

[39] J. P. Delgado, "Relics of the Kamikaze", *Archaeology*, 56(1), (2003) Online. Available HTTP: http://www.archaeology.org/0301/etc/kamikaze.html (accessed 11 March 2008).

[40] Various versions of the scroll can be viewed on the *Scrolls of the Mongol Invasions of Japan* web site: T. D. Conlan, *et al.*, *Scrolls of the Mongol Invasions of Japan*. Online. Available HTTP: http://www.bowdoin.edu/mongol-scrolls/ (accessed 19 August 2008).

[41] Meng Yuanlao, *Dongjing Meng Hua Lu Zhu*, annotated by Deng Zhicheng [*MHL*], p. 202.

[42] *Ibid.*, p. 205n.

[43] Wang Zhi, *Za Zuan Xu* [*ZZX*], p. 54.

[44] *SS*, xiii, juan 186 [zhi 139], p. 4563.

[45] Li Gang, *Jingkang Zhuan Xin Lu* [*JZL*], juan zhong, p. 40.

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already known in the Jin Empire, then it must have been acquired shortly afterwards, when Kaifeng and northern China were seized from Song.

Explosive bombs continued to be developed in China during the late twelfth and early thirteenth centuries. A major advance was the replacement of the paper casing used in 1161 (and probably earlier) by metal, often cast iron. Cast iron tends to be brittle, so that it will shatter into pieces quite readily. Thus, cast iron bombs were effective fragmentation weapons. It must be noted, however, that making bombs of this kind was technically difficult. The iron had to be strong enough to survive being flung from a catapult and hitting the ground, but weak enough to shatter when the gunpowder inside exploded. The bomb had to have a fuse which could be lit before firing, not come loose during firing, burn while the bomb was flying through the air, and then cause the bomb to explode after it reached its target. It had to be possible to fill the bomb casing with gunpowder, but only a very small hole could be left in it for the fuse. If the hole was too large, then the casing would not burst when the bomb exploded. It is, in fact, much easier to make cannon than bombs with metal casings. A cannon simply had to be strong enough not to burst when fired, but otherwise was technically not very difficult to make. Early cannon, however, were only able to fire solid projectiles, which must usually have had less effect on their targets than explosive bombs. Cannon did not become significantly more effective weapons than bombs fired by catapults until they had been developed to the point where their range considerably exceeded that of catapults. However, cannon always had certain advantages over catapults: they were more compact, could be brought into action more quickly, and needed less manpower to handle them.

Bombs with metal casings were certainly in use in China by the early thirteenth century. From 1217, under pressure from the Mongols, the Jin Empire began a series of campaigns against Song, attempting to compensate for its losses in the north by gains in the south. Its forces penetrated far into the area between the Huai and Yangtze Rivers. In 1221, a Jin army laid siege to the town of Qizhou (near modern Qichun in Hubei province). An eye-witness account of the siege records that:

> They attacked the north-western round tower most fiercely. After firing stone balls they followed up with iron bombs. They were shaped like gourds, with a small opening, and made from cast iron two inches [*cun*] thick. They shook the city wall.[46]

These cast-iron bombs were apparently very effective. When one of the defenders' catapults was hit by such a bomb, one of the catapult men had half his head blown off and six or seven others were wounded.[47] It is interesting that the Jin forces fired non-explosive shot first. This was probably to assess range and direction. Once the solid shot were falling in the right place, then bombs were fired. This avoided wasting the bombs, which of course were more complicated to make than solid shot. Similar bombs were also used in fighting between Jin forces and the Mongols. In 1232, when the Mongols attacked Kaifeng, a kind of bomb was used which was "an iron pot filled with gunpowder". When it exploded, "the noise was like thunder and could be heard at a distance of more than one hundred *li*" (one

[46] Zhao Yuyu, *Xinsi Qi Qi Lu* [*XQL*], p. 479.
[47] *XQL*, p. 477; the first man was certainly killed and not just blinded, as stated in Needham, *op. cit.*, 170n.

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li was about 500 metres or one-third of a mile). It destroyed everything in an area of more than half a *mu* (there were about 6 or 7 *mu* to an acre; one *mu* was about 600 square metres). It is important, for reasons that will become clear later, to note in passing that the vocabulary of 'fire' and 'burning' is used to describe the explosion and its effects. Thus: "When the bomb went off and the fire burst out [*pao qi huo fa*] ... the area it burned was more than half a *mu* [*suo ruo wei ban mu zhi shang*], and the armour and iron touched by the fire was all pierced [*huo dian zhu jia tie jie tou*]." This was probably appropriate, as early gunpowder no doubt would have produced a large flash of flames and a great deal of smoke. The besiegers of Kaifeng also approached the city wall under the cover of a mobile shelter that protected them from arrows and stones. Having reached the wall, they began to dig into it, to breach it. The defenders could do nothing. Then someone thought of lowering a bomb on an iron cable from the wall above the attackers' shelter. When the bomb exploded, the men and their shelter were all blown to pieces.[48]

So it is quite clear that, by the early 1200s, bombs with metal casings, that were capable of causing great destruction when they exploded, were being made and used in China. From a technical point of view, the Chinese undoubtedly had the ability to make cannon by this period. Indeed, as already pointed out, cannon were easier to manufacture than bombs. They might therefore be expected to have been produced earlier. There is still uncertainty, however, about the date at which cannon first began to be made and used. There are a number of cannon that have been found in China at various times and are believed possibly to date from about 1200 or shortly thereafter. One, unearthed in Wuwei in Gansu province in 1980, may be from the Xi Xia period and therefore no later than 1227.[49] This Wuwei cannon is a metre long and weighs 108.5 kg (239 lb). Its internal diameter is 12 cm (5 in). It was found associated with a solid iron cannonball about 9 cm (4 in) in diameter and a small amount of gunpowder.[50] Unfortunately, it is usually impossible to date such cannon very precisely, unless they are actually marked with a year of manufacture. Until a few years ago, the earliest known cannon bearing a date was one in the collection of the Museum of Chinese History in Beijing. Unearthed at Fangshan in 1940, it has a date cast onto it equivalent to 1332.[51] Recently, however, an older bronze cannon has been discovered. First put on public display as part of a special exhibition of Mongol and Yuan culture at the Sackler Museum at Beijing University in autumn 2004, it carries an inscription in the 'Phags-pa script including a date equivalent to 1298.[52] It is now in the collection of the Museum of Mongol/Yuan Culture at Xilinhot in Inner Mongolia. It weighs 6,210 grams (13 lb 11 oz) and is 34.7 cm (just under 14 in) long.[53] It is therefore now certain that cannon were being made in China before the end of the thirteenth century.

[48] *JS*, vii, juan 113 [liezhuan 51], pp. 1496–1497.

[49] Liangzhouqu Renmin Zhengfu Bangongshi, *Xi Xia Wenhua*. Online. Available HTTP: http://www.gsliangzhou.gov.cn/lzwh/xx.htm (accessed 11 June 2006).

[50] Su Lihua, *Wuwei Pao – Shijieshang zuizaode tonghuopao*. Online (2007). Available HTTP: http://www.silkroaddunhuang.com/ShowF/875.htm (accessed 18 August 2008).

[51] Cao Zixi (ed.), *Beijing Lishi Gangyao*, (Beijing, 1990), p. 318.

[52] Wu Guangshen, *'Tianxia Diyi Huopao' Zai Beida Wenbo Xueyuan Bowuguan Shouci Liangxiang*. Online (2004). Available HTTP: http://news.sohu.com/20040827/n221765189.shtml (accessed 11 June 2006).

[53] Cheng Weiguang, *Shijieshang Zuizaode Huopao*. Online (2004). Available HTTP: http://www.erdsi.net/sjszzdhp.html (accessed 20 August 2005).

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Of course, this single surviving dated cannon from the late thirteenth century is unlikely to have been the first cannon ever made. It must be highly likely that cannon were being manufactured at least a few years before 1298. Indeed, there is iconographic evidence of the existence of cannon much earlier, possibly as early as 1128. A stone relief sculpture at Dazu in Chongqing Municipality, in Cave 149 of the Bei Shan group, depicts a demon holding what appears to be a vase-shaped bombard firing a cannonball.[54] It has been doubted whether the weapon is really a cannon,[55] but the stated reasons for these doubts are questionable. It should be noted that the date of the sculpture does not seem to be at issue. The demon has been identified as a "wind-spirit [*feng shen*]" holding a "wind-bag [*feng dai*]". The other demons depicted in the same group, however, hold various kinds of weapons, including swords, spears and what appears to be a bomb or grenade. It might therefore be presumed that what this demon is holding is also a weapon. It has been further argued that the technology to make cannon could not have existed so early, that it would be impossible for such a large cannon to be held in the way that the demon is holding it, and that the cannonball was not originally part of the sculpture but was added later when the sculpture was repaired. None of these arguments is at all persuasive. As has been shown above, fire-lances existed at least as early as the year 1000 and explosive gunpowder had almost certainly been developed by the 1120s. Since the Chinese undoubtedly also had the technology to cast large metal objects at that time, there is no technical reason why cannon could not have existed by 1128. The figure depicted is a supernatural being, so that it might well have been supposed to have the power to hold and fire cannon. It is also difficult to understand why someone repairing the sculpture should add an object that was not originally shown. The cannonball may have been repaired after 1128, but the likelihood must surely be that it was part of the original depiction and was merely restored later. All in all, this sculpture is significant evidence of the early existence of cannon.

There is also some indication in Chinese literature that cannon may well have existed prior to 1298. In 1272, during the final campaign of the Mongols against Southern Song, an attempt was made to break the siege of Xiangyang. A force of 3,000 men in 100 small boats, each boat holding 30 men, tried to force the blockade imposed by the Mongol armies. Each boat was equipped with various kinds of weapons, including fire-lances and '*huopao*'.[56] These '*huopao*' may well have been cannon. The other major possibility, that they were catapults firing explosive or incendiary bombs, is virtually ruled out by the size of the boats. Although it was certainly possible to mount catapults on large boats or ships, in a small boat it was impractical because the swinging beam of the catapult would have destabilised the boat. Even if it was possible to fit a catapult of worthwhile size into a small boat, accurate fire would surely have been impossible. A small boat was simply not a sufficiently stable firing platform. Also, Chinese catapults were not normally counterweighted, but were fired by a team of men pulling on ropes. Such activity in a small boat manned by only 30 men is difficult to imagine. On the other hand, cannon of modest size could easily be mounted in quite a small boat and fired with reasonable accuracy. Thus, these '*huopao*' were most

[54]G.-D. Lu, J. Needham, & C.-H. Phan, "The Oldest Representation of a Bombard", *Technology and Culture*, 29 (3) (1988), pp. 594–605; K. Chase, *Firearms: a Global History to 1700*, (Cambridge, 2003), p. 32.

[55]Liu Xu, *Zhongguo gudai huoyao huoqi shi* (Zhengzhou, 2004), pp. 28–29.

[56]Zhou Mi, *Qi Dong Ye Yu* [*QDYY*], juan 18, pp. 40–42; Liu Yiqing, *Qiantang Yi Shi* [*QTYS*], juan 6, p. 7.

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probably cannon. Another possible case of cannon mounted in boats is mentioned in the *History of the Jin Dynasty*. After the fall of Hezhong (modern Puzhou in Shanxi province) to the Mongols early in 1232, some 3,000 of the defenders escaped and fled in boats along the Yellow River. After travelling a short distance, under fire from the bank, they found their way barred by warships aligned across the river. The warships were equipped with '*huopao*', which were fired continuously. "The fire from the *pao* was bright, so that it could be seen that there were only a few men in the northern ships, so they forced a way through them and were able to reach Tongguan ...".[57] Almost certainly it was the muzzle flashes from cannon which illuminated the ships. Bombs would have exploded at a distance from the point from which they were fired, so that they would not have illuminated it very well. Moreover, since the catapults used to hurl explosive bombs were usually manned by teams of a dozen or more, the fact that there were few men in the northern (i.e. Mongol) ships also implies that these '*huopao*' were most likely cannon. They are said to have been called '*zhen tian lei*', that is, 'heaven-shaking thunderbolts'. The same name was also given to the bombs used by Jin forces defending Kaifeng in 1232, as described above. However, in view of the frequently ambiguous usage of terms for gunpowder weapons, this cannot be taken as definite indication that these two weapons were of exactly the same type.

The implication that cannon existed in 1259, when 'shooting fire-lances [*tuhuoqiang*]' were made, has already been mentioned above. There are also very interesting lists of gunpowder weapons made and repaired at Jiankang (modern Nanjing) during a period of about 27 months in 1259–61. 38,359 new weapons were manufactured, as follows:

> Iron bomb casings: ten *jin* [Chinese pounds] in weight - 4; seven *jin* in weight – 8; six *jin* in weight – 100; five *jin* in weight – 13,104; three *jin* in weight – 22,044. Incendiary arrows for bows – 1,000. Incendiary arrows for crossbows – 1,000. '*Tuhuotong*' – 333. Grenades [*huo jili*] – 333. Disposable fire-lance heads – 333. '*Pili huopao*' casings – 100.[58]

There is no difficulty in identifying most of these weapons, although the translation 'grenades' is deliberately somewhat vague as it is uncertain whether these weapons were explosive or incendiary. The '*pili huopao* casings' may have been for paper bombs, like that used in 1161 at Caishi. The small number made suggests that they were not much used by this period. Perhaps they were still occasionally utilised for special bombs, like that of 1161, that spread noxious chemicals. It is also very interesting to note that, by this time, fire-lance heads that were disposable were being produced. This presumably means that fire-lances were being made with heads that could be easily detached and exchanged, so that once a head was spent it could be quickly replaced with a new one and the weapon could be fired again. A pair of soldiers could no doubt have carried one fire-lance and several heads between them. The most interesting items are the '*tuhuotong*'. About a century later, '*huotong*' (literally, 'fire-tube') was certainly used to mean cannon.[59] Since there is no description of these weapons here, it is impossible to be sure about what they were. However, since the '*tuhuoqiang*' of

[57] *JS*, vii, juan 111 [liezhuan 49], p. 2446; it should be noted that this passage is translated wrongly in J. Needham, *Science and Civilisation in China*, vol 5, part 7, *Military Technology: The Gunpowder Epic*, (Cambridge, 1986), p. 171.
[58] Zhou Yinghe, *Jingding Jiankang Zhi* [*JJZ*], juan 39, p. 1981.
[59] Liu Xu, *Zhongguo gudai huoyao huoqi shi* (Zhengzhou, 2004), p. 55.

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1259 were fire-lances that fired balls, it may be surmised that these '*tuhuotong*' also fired projectiles and were, in fact, cannon. (The Chinese character '*tu*' is the same in each case.)

The list of weapons repaired during the same period includes large numbers of incendiary arrows, for both bows and crossbows, 502 '*tuhuotong*', 1,396 disposable fire-lance heads, 404 grenades ['*huoyao jili*'], 208 small iron bombs, 74 iron fire-buckets ['*tie huo tong*'] and 23 iron fire-awls ['*tie huo zhui*'].[60] The last two items were probably used for lighting the fuses of gunpowder weapons: the 'fire-buckets' were for holding burning charcoal or something similar and the 'fire-awls' were iron points that were heated in the 'fire-buckets' until they were hot enough to light the fuses. Interestingly, it seems that red-hot irons were also used for lighting gunpowder weapons in France in the mid-fourteenth century.[61] The small number of bombs repaired reflects the fact that bombs, once they had been thrown and had exploded, could rarely be re-used. The comparatively large number of disposable fire-lance heads and of '*tuhuotong*' that were repaired indicates that these were items that could easily be collected and refurbished. Again, this tends to suggest that the '*tuhuotong*' may have been cannon. Early cannon would often have needed repair, as the gunpowder exploding inside them (at a very high temperature) soon caused the metal to degrade. Unlike bomb casings, however, they were not designed to shatter and were intended to be re-used over a period. There is an early mention of '*huotong*' in a work dating from about 1230.[62] However, it is not at all clear whether this fired projectiles and was therefore a gun or whether it was more like a fire-lance.[63]

I would, somewhat tentatively, propose that the sequence of development of gunpowder weapons in China was as follows: the first military use of gunpowder occurred in about the year 900.[64] Various weapons using incendiary gunpowder, including fire-lances, fire-arrows and incendiary bombs, were made and brought into use by about 1000. Very probably by about 1120, and certainly no later than about 1150, explosive gunpowder had been developed, and was being used in firecrackers as well as in bombs. Cannon may have made their first appearance at about this time. There is certainly no technical reason why they could not have been made in China then. Explosive bombs with iron casings, flung from catapults, were in use by about 1220. Cannon definitely existed before 1300 and may well have been in regular use throughout the thirteenth century. It is very likely that they were used during the last campaigns of the Mongols against Southern Song, during the 1270s, as I have already suggested elsewhere.[65] It may be significant that the earliest gunpowder weapons, such as fire-lances, are most often mentioned as defensive weapons. It may well be that they were more effective in defence than in attack. This might, at least partly, explain the situation in the Far East during the eleventh and twelfth centuries, when several states existed simultaneously and frequently fought among themselves, without being able to achieve much more than a series of stalemates.

[60] *JJZ*, juan 39, p. 1981.
[61] L. Lacabane, *De la poudre à canon et de son introduction en France*, (Paris, 1844), p. 17.
[62] *Xing Jun Xu Zhi* [*XJXZ*], juan xia, p. 2318.
[63] J. Needham, *Science and Civilisation in China*, vol 5, part 7, *Military Technology: The Gunpowder Epic*, (Cambridge, 1986), p. 230.
[64] Liu Xu, *Zhongguo gudai huoyao huoqi shi* (Zhengzhou, 2004), p. 13.
[65] S. G. Haw, *Marco Polo's China: a Venetian in the realm of Khubilai Khan*, (London and New York, 2006), pp. 37–38.

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During the Yuan dynasty, the production of saltpetre was controlled and taxed by the state. There is unfortunately a lack of detailed information about this. The compilers of the official *History of the Yuan Dynasty* noted that there were inadequate records regarding the tax on saltpetre.[66] However, they were able to record the amount of revenue produced by the saltpetre tax in Jinninglu (centred on modern Linfen in Shanxi province).[67] They also recorded that, in 1265, the private production of saltpetre in Shandong East was banned.[68] A Saltpetre Bureau [*Xiaojian Ju*] is briefly mentioned in the biography of Zhang Hui, where it is said that he submitted a memorial at the beginning of the reign of Khubilai Khan suggesting that it be abolished.[69] A similar memorial is also preserved in a collection of the works of Wang Yun.[70] All this suggests that the Mongols took a serious interest in saltpetre and that its production may have been at least partly monopolised by the government, no doubt because of its military importance.

During the last decades of the Yuan dynasty, in the mid-1300s, cannon were frequently and regularly used, both by imperial armies and by rebel forces.[71] It was even claimed that the firearms used by the forces of Zhu Yuanzhang, founder of the Ming dynasty, were the principal reason for his success in conquering all China.[72] Cannon were in common use during the early period of the Ming dynasty, at least until 1500. Shortly thereafter, the Chinese found that guns from Europe and the Ottoman Empire were superior to their own and the independent development of firearms in China ended.[73] It has been suggested that the reason for the failure of the Chinese to continue the development of gunpowder weapons during the late fourteenth and fifteenth centuries, so that their technology fell behind that of Europe and Western Asia, was that their principal enemies at this period were the Mongols and that early firearms were not effective weapons against the light cavalry of the nomads.[74] This is clearly not true. The originator of the hypothesis in fact quotes sources that contradict it.[75] It is undoubtedly the case that early firearms were not effective cavalry weapons, principally because they were difficult to use while riding and could not be reloaded on horseback. However, they gave bodies of infantry fighting against cavalry a huge advantage, that of range. The firearms used by the Ming armies against the Mongols in the early 1400s were capable of inflicting serious casualties while the Mongols were still too far from their Chinese enemies for their bows to be of any use at all. Thus, when the Yongle Emperor led his final campaign against the Mongols into north-east Mongolia in 1424, he gave the order: "If the enemies come, first attack them with the guns. Afterwards, follow up with the long bows and strong crossbows".[76] The actual effectiveness of the guns of this period is clearly shown in an account of a battle between Ming forces and Mongols in 1414. The Ming army was drawn up in formation facing more than thirty thousand Mongols

[66] Song Lian, *et al.*, *Yuan Shi* [*YS*], viii, juan 94 [zhi 43], pp. 2382–2383.
[67] *YS*, viii, juan 94 [zhi 43], p. 2385.
[68] *YS*, i, juan 6 [benji 6], p. 106.
[69] *YS*, xiii, juan 167 [liezhuan 54], p. 3924.
[70] Wang Yun, *Qiu Jian Ji* [*QJJ*], juan 91, p. 10.
[71] Liu Xu, *Zhongguo gudai huoyao huoqi shi* (Zhengzhou, 2004), pp. 57–59.
[72] K. Chase, *Firearms: a Global History to 1700*, (Cambridge, 2003), p. 34.
[73] *Ibid.*, pp. 141–142.
[74] *Ibid.*, pp. 25–27.
[75] *Ibid.*, pp. 44–46.
[76] *Ibid.*, p. 45; Yang Rong, *Bei Zheng Ji* [*BZJ*], p. 132.

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on the hills around them. When the Mongols attacked: "The guns fired on all sides. The bandits [i.e. the Mongols] were frightened and abandoned their horses and fled on foot". When they regrouped and attacked once more, the guns were again put to effective use. The Mongols were defeated, suffering heavy casualties, and withdrew.[77] When the Chinese again encountered some of the Mongols a few days later, the main Mongol force withdrew "fearing that the guns would come again".[78] A Chinese source of the period recounts that a single shot from one of the guns used in these campaigns could kill two men and a horse.[79] It is sometimes asserted that bows and arrows were superior to guns until as late as the mid-nineteenth century,[80] but the evidence adduced above shows that this is clearly false.[81]

It has been suggested that, in spite of the efficacy of these firearms, the sheer difficulty of carrying them into the Mongolian steppes and bringing them to bear against the nomads' forces made them almost useless.[82] Yet the Yongle Emperor was able to campaign far out into Mongolia on several occasions, and not without success. Even if the nomads avoided giving battle, relying on the superior mobility of their fighting forces to keep well away from the enemy, this did not mean that they avoided all losses. Only the fighting men with their horses could move swiftly. Their womenfolk, children and old people, together with their flocks and herds, were very much less mobile. The avoidance of battle could be very costly if the advancing enemy chanced upon the nomads' families and their animals. Merely having to move during the wrong season to avoid falling into enemy hands could result in losses, for young animals might be unable to keep up with their mothers and even adult animals would be able to spend less time grazing and fattening before the winter. Finally, the movement of a large army, with cavalry horses and the animals of the baggage train, across pastures that the nomads' own flocks and herds would usually have grazed, could result in many of the nomads' animals starving during the winter. Grass stops growing in Mongolia during the autumn, so that winter pastures must have grass left standing from earlier in the year. Mongols, and nomads in general, did not harvest and store hay. If the grass of the winter pastures had already been eaten and trampled by an invading army and its animals, then the nomads' animals went short of food during the long, cold Mongolian winter. Thus, avoiding battle was not an easy option, but a tactic of near-desperation.

Firearms have never at any time been really effective cavalry weapons. Until well into the nineteenth century, the principal weapons of cavalry units were sabres, lances and suchlike. Even today, it is at least very difficult to reload a gun on horseback, as the process requires the use of both hands, leaving none to control the horse. Firing a gun from a moving horse with any degree of accuracy also requires a great deal of training, not only of the rider but also of the horse. By the time that firearms had been developed to the point where they

[77] Jin Youzi, *Jin Wenjing Gong Bei Zheng Lu* [*BZL*], juan 2 [hou lu], p 124; K. Chase, *Firearms: a Global History to 1700*, (Cambridge, 2003), pp. 44–45; my interpretation of this passage differs somewhat from that of Chase.

[78] *BZL*, juan 2 [hou lu], p. 124; K. Chase, *Firearms: a Global History to 1700*, (Cambridge, 2003), p. 45.

[79] *Ming Shi Lu* [*MSL*], *Tai Zong Shi Lu*, juan 105, p. 2b [xii, p. 1360]; K. Chase, *Firearms: a Global History to 1700*, (Cambridge, 2003), p. 46.

[80] See, for example, D. Morgan, "The Decline and Fall of the Mongol Empire", *Journal of the Royal Asiatic Society*, 18(4) (2009), pp. 431–2; and D. Ostrowski, "The Replacement of the Composite Reflex Bow by Firearms in the Muscovite Army", *Kritika: Explorations in Russian and Eurasian History*, 11(3), (2010), p. 514.

[81] See also D. Ayalon, *Gunpowder and Firearms in the Mamluk Kingdom*, (London, 1956), pp. 88–9, 108–111: Ayalon ascribes the conquest of Mamluk Egypt by the Ottomans to the Ottoman superiority in firearms.

[82] K. Chase, *Firearms: a Global History to 1700*, (Cambridge, 2003), pp. 5, 46–47.

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had become truly useful as cavalry weapons, they had also become so effective as infantry weapons that they rendered cavalry obsolete. Guns with some kind of magazine that could fire several shots before they needed to be reloaded were much more useful to cavalry than single-shot weapons. However, they also enabled an infantryman to fire several shots in the time that charging cavalry took to close to effective fighting range. A horse and rider, and even more a body of horsemen operating as a unit, were simply too large a target for infantry armed with guns capable of rapid fire. By the late nineteenth century, although cavalry units still existed in many armies, they were either of very limited usefulness or were, in reality, used as mounted infantry, riding to the area of battle but dismounting to fight.

The real reason that the Chinese more or less stopped developing firearms after the founding of the Ming dynasty is, I believe, very simple. It is that they did not need to. Their principal enemies at the period, the Mongols, did not use firearms. Therefore, even if Chinese firearms were rather primitive, they were clearly greatly superior to the weapons of their enemies. In Europe and Western Asia, by contrast, there were many states which rather frequently fought among themselves, all of them possessing firearms. There was, therefore, a continual incentive to improve firearms, to make them better than those of the enemy. This is surely the true reason why, by about 1500, Chinese firearms technology had fallen behind that of Europe and Western Asia. The Chinese had simply not faced any competition in the development of gunpowder weapons and had therefore received no stimulus to improve the technology of firearms.

The final question that must be considered here is the extent to which Mongol armies used gunpowder weapons during their campaigns in the 1200s. I have just stated above that the Mongol armies faced by Ming forces in the early 1400s and later did not use firearms. It seems quite probable that the Mongols themselves may never have taken up the use of firearms, and in any case they probably produced no saltpetre in Mongolia, so could not have made gunpowder. The situation during the 1200s and up until 1368 was quite different, however. The armies commanded by the Mongols at that period included large numbers of non-Mongol troops. Leaving aside the other steppe-nomads, who fought on horseback and used similar weapons to the Mongols themselves, by shortly after 1200 there were Uighurs from Gaochang, Jurchens, Khitans and north Chinese from the Jin Empire (many of whom joined the Mongols long before the final conquest of Jin) and Tanguts and others from the Xi Xia state. Jin armies certainly used gunpowder weapons regularly in the early 1200s, and so the Mongols must have been well aware of their efficacy. Indeed, there are records of Mongol forces using such weapons when fighting against Jin. The use of '*huopao*' at Hezhong in 1232 by Mongol forces has already been mentioned above: whether these weapons were cannon or not, they were certainly gunpowder weapons of some kind. It should be noted here that, despite what has been suggested by a number of writers on the Mongol conquests, there is no very strong evidence that the Mongols ever used catapult-thrown naphtha firebombs. The Chinese certainly used pumped flame-throwers fuelled by naphtha, or some kind of petroleum product, during the eleventh century,[83] but these appeared in China only after

[83]J. Needham, *Science and Civilisation in China*, vol. 5, part 7, *Military Technology: The Gunpowder Epic*, (Cambridge, 1986), pp. 80–86.

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the discovery of low-nitrate gunpowder. Incendiary bombs employing gunpowder were probably more effective, and must certainly have been safer to use, than naphtha firebombs.

The idea that the Mongols used naphtha or 'Greek fire' seems to derive, at least partly, from the statement of John of Plano Carpini that the Tartars (i.e. the Mongols and their allies) "throw Greek fire" when attacking fortresses. He is not a very reliable witness, however. His information regarding Mongol methods of fighting must have been more or less entirely based on hearsay, for he does not claim ever to have personally witnessed any Mongol battles or sieges. He goes on to say that: "sometimes they even take the fat of the people they kill and, melting it, throw it on to the houses, and wherever the fire falls on this fat it is almost inextinguishable".[84] This is clearly just another tall story of the hellish Tartars. That it was often very difficult to extinguish the fires thrown by the Mongol armies is probably true, but not because human fat was used to fuel them. The incendiary compounds contained saltpetre which supplied oxygen that kept them burning even if they were doused with water. The story of the use of human fat was surely just an attempt to explain something that seemed inexplicable to those ignorant of Chinese gunpowder technology. John almost certainly refers to Greek fire only because gunpowder-based incendiary compounds were unknown to him and his sources. Indeed, it was long ago noticed that mediaeval European writers used the term 'Greek fire' of various different incendiary weapons, including some that contained saltpetre.[85]

There are also several mentions of the use of naphtha ['*naft*'] by Mongol armies in Juvaini's account of the Mongol conquests. However, as with John of Plano Carpini's account, it must be considered possible that he wrote of 'naphtha' either because he did not understand exactly what the incendiary substance was, or because he could think of no other word to use for it. He sometimes apparently makes a distinction between "fire" and "naphtha". For example, at Khojend the Mongol army is said to have thrown "fire, naphtha and stones".[86] At Bokhara, the defenders of the citadel threw "pots of naphtha", but the attackers hurled "fire".[87] Perhaps the distinction was between naphtha, that is, some kind of petroleum-derived substance, and the Chinese bombs that used gunpowder-based incendiary mixtures. It must also be possible, however, that 'naphtha' was used as a general term for incendiary material and that 'fire' actually meant explosive gunpowder. It may be remembered that the Chinese used the vocabulary of 'fire' and 'burning' when describing explosive gunpowder (see above). Indeed, the Chinese word for gunpowder was '*huoyao*', meaning 'fire compound'.

It should also be noted that, in mediaeval Arabic, the word '*naft*' was not necessarily used to mean 'naphtha', but was applied to incendiaries in general[88] and even to gunpowder. "The term *naft* was used originally for military fires of any composition, and as soon as the new mixture of *saltpeter-sulphur-charcoal* was known, the word *naft* was applied to it".[89] This

[84] C. Dawson (ed.), *The Mongol Mission*, (London, 1955), p. 37.

[85] Reinaud and Favé, *Histoire de l'Artillerie, 1re partie; du Feu Grégeois, des feux de guerre, et des origines de la poudre à canon, d'après des textes nouveaux*, (Paris, 1845), pp. 49–50.

[86] 'Ala-ad-Din 'Ata-Malik Juvaini, *The History of the World-Conqueror*, trans. J. A. Boyle, 2 vols., (Cambridge, Mass., 1958), i, p. 92.

[87] *Ibid.*, i, p. 106.

[88] Reinaud and Favé, *Du Feu Grégeois*, p. 69.

[89] Ahmad Y. al-Hassan, *Gunpowder Composition for Rockets and Cannon in Arabic Military Treatises In Thirteenth and Fourteenth Centuries.* Online. Available HTTP: http://www.history-science-technology.com/Articles/articles%202.htm (accessed 3 January 2011).

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may well have been true of Persian also. Thus, it seems quite likely that thirteenth-century Persian writers such as Juvaini may have used '*naft*' to mean gunpowder-based incendiaries, as just suggested. Juvaini's 'fire' would, therefore, mean explosive gunpowder. Juvaini may well simply have been roughly translating the Chinese term '*huoyao*'. He does seem to have been familiar with Chinese terminology and to have used approximate translations of this kind in other cases. For example, Juvaini gives an extremely interesting description of the Mongols' attack on the Assassins' castle of Maimun-Diz:

> [A] *kaman-i-gav* ['ox's-bow'], which had been constructed by Khitayan craftsmen and had a range of 2,500 paces, was brought to bear on those fools, ... and of the devil-like Heretics many soldiers were burnt by those meteoric shafts. From the castle also stones poured down like leaves, but no more than one person was hurt thereby.[90]

Note that Juvaini contrasts the stones thrown by the defenders, which (each, presumably) hurt only one person, with the "meteoric shafts" from the '*kaman-i-gav*', which seem each to have killed or wounded several soldiers. This '*kaman-i-gav*' must have been one of the great Chinese crossbows or ballistae, several of which are illustrated and described in the *Wu Jing Zong Yao*.[91] A common Chinese name for these great crossbows was "*ba niu nu* [eight oxen crossbows]",[92] whence, probably, Juvaini's "ox's-bow".

The fact that Juvaini says that "many soldiers were burnt" by the shafts from the great crossbow, suggests that the crossbow bolts had gunpowder charges attached to them, very possibly of explosive gunpowder. The *Wu Jing Zong Yao* states that gunpowder could be attached to the bolts fired by these great crossbows.[93] At the time that this work was written, this would of course have meant incendiary gunpowder, but it seems unlikely that, when explosive gunpowder had been developed, it would not also have been used in the same way. The effect of such weaponry is very clearly illustrated by what happened at Maimun-Diz. The fanatical Assassins, whose castles high in the mountains had been generally considered more or less impregnable, withstood the bolts fired by the great crossbow for just one day. Then they offered to surrender. "Having that day experienced the force of the Mongols' arms they ceased fighting, and the garrison of the castle after the heat of war knocked at the door of peace".[94]

The biography of Guo Baoyu in the official history of the Yuan dynasty contains much that is of interest. Guo was from north China and a descendant of someone who had held office under the Tang dynasty. He was very knowledgeable in astronomy/astrology and military science, and a good horseman and archer. In the later years of the Jin dynasty, he held the rank of *mengan* or *mingan* (commander of one thousand troops) and led forces defending the Jin Empire against Mongol attacks. He apparently read in the stars that the Jin dynasty would fall and, with many Jin soldiers, surrendered to Mukhali in 1211. He was taken to meet Chinggis Khan, who asked for his advice about attacking the Jin Empire. He is said to have been behind many of the Mongols' early government and military policies. In

[90] Juvaini, *History of the World-Conqueror*, ii, p. 631.
[91] *WJYZ*, qian ji, juan 13, pp. 7–8, 11–13.
[92] *Ibid.*, qian ji, juan 13, p. 7.
[93] *Ibid.*, qian ji, juan 13, p. 8.
[94] Juvaini, *History of the World-Conqueror*, ii, p. 631.

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1213, he followed Mukhali in attacking Jin and took a number of cities, including Taiyuan in Shanxi. The following year, he accompanied Chingghis Khan on his campaigns against the Karakhitay and Khwarazm. He was wounded in the chest by an arrow but recovered after being given special treatment by order of the Khan. Soon he was back in battle and distinguished himself in fighting against Khwarazmian forces. He was involved in the taking of Samarkand (Semisgen; Xiansigan). In 1220, at the Amu Darya, he faced prepared defence works and ships on the river. He ordered fire-arrows to be used against the ships, which were immediately set ablaze. The large Khwarazmian army was then defeated and Guo went on to take four cities.[95] This defeat on the Amu Darya was a major blow to the Khwarazm Shah's forces. When he heard that the Mongol armies had crossed the river, he fled.[96]

This is a brief but fascinating account of an early defector from Jin to the Mongols and the advice and skills he was able to offer in the service of his new masters. It was a large part of the genius of Chinggis Khan and the Mongols that they were always ready to recognise and use the talents of anyone, from whatever background. Guo Baoyu clearly played a major role in the early campaigns of the Mongols against the Jin Empire and brought north Chinese techniques and know-how to their assistance. His army used Chinese incendiary weapons in the earliest Mongol campaigns towards the West. Perhaps this is why the Khwarazm Shah offered so little resistance to the advancing Mongol armies.[97] Their Chinese weaponry was simply too terrifying. For soldiers who had never before faced any kind of gunpowder weapon, incendiary arrows and bombs that were "almost inextinguishable" must have been highly demoralising. Fire-lances and explosive bombs, which were certainly part of the Jin arsenal in the early 1200s, would surely have created panic. The fact that the Chinese had weapons unknown to other peoples is clearly stated by Hayton (also called Hetoum) of Armenia, who says that the Cathayans "ont diverses manieres d'armes et d'engins, lesquels ne ont les autres nacions [have various kinds of weapons and devices which other nations do not have]".[98]

Guo Baoyu had two sons who followed him in joining the Mongols and distinguished themselves in battle. One of them, Deshan, became a *wanhu* (commander of ten thousand soldiers). He took the Jin city of Shanzhou (modern Sanmenxia municipality in Henan) but was then killed while attacking Tongguan.[99] The other, Dehai, took an active part in the final campaign against the Jin Empire. Eventually, in 1234, he was wounded by a *pao* (catapult or possibly cannon) while fighting in Henan, and later died of his wounds. He had a son who was cared for (presumably after his death) by Shi Tianze, another north Chinese who had joined the Mongols and is well-known to historians today.[100]

Another early defector from Jin to the Mongols was Xue Talahai. He joined Chinggis Khan, with more than 300 of the soldiers under his command, in 1214, when Mongol troops reached the northern end of the Juyong Pass (the main way to Jin Zhongdu, modern Beijing, from Mongolia). He was a catapult specialist and led catapult artillery units in the

[95] *YS*, xii, juan 149 [liezhuan 36], pp. 3520–3521.
[96] Juvaini, *History of the World-Conqueror*, ii, pp. 380–381.
[97] D. Morgan, *The Mongols*, 2nd edn, (Oxford, 2007), p. 61.
[98] Hayton, *La Flor des Estoires de la Terre d'Orient*, (Paris, 1906), p. 390.
[99] *YS*, xii, juan 149 [liezhuan 36], p. 3522.
[100] *YS*, xii, juan 149 [liezhuan 36], pp. 3522–3523; on Shi Tianze, see De Rachewiltz *et al.* (eds) *In the Service of the Khan: Eminent Personalities of the Early Mongol-Yuan Period (1200–1300)*, (Wiesbaden, 1993), pp. 27–44.

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Mongol campaigns against Xi Xia, Khwarazm and other states and peoples, as far west as the Kipchak. He was awarded the rank of General Commander (*Du Yuanshuai*). Under Ögödei, he took part in the final campaigns against the Jin Empire, but died in 1233. Two of his sons in turn succeeded him as General Commander. The younger, Junsheng, was involved in fighting in Sichuan and adjacent areas against Song, and then saw action against the rebellious Li Tan, using catapults to break the defences of Ji'nan. He died while involved in the siege of Xiangyang.[101]

These and others from the Jin and Tangut states undoubtedly rendered great service to the Mongols during the early period of their conquests. The value of north Chinese troops in attacking fortified positions and fighting in difficult terrain is attested by the recorded words of the great Mongol general, Aju [Azhu]: "Those I command are Mongol troops. If mountains and water or forts and stockades are encountered, only north Chinese troops [*Han jun*] are good". He then requested that north Chinese troops be ordered to assist him and his request was granted. This was in 1268.[102]

A few Mongols themselves not only understood the value of Chinese artillery weapons but also learned how to use them. Anmuhai [Amukhai] was in service under Chinggis Khan: the Khan asked him about the best ways to attack walled towns. He replied that stones thrown by catapults should be used first, because they were powerful and had a long range. The Khan was pleased and ordered him to become a catapult artilleryman. In 1214, he served under Mukhali in attacking the Jin Empire. Chinggis Khan is reported to have advised Mukhali to use catapults against walled towns. Anmuhai selected more than 500 men to be trained as catapult artillerymen under his command. In 1232, under Ögödei, he played a useful part in the final campaign against Jin in Henan. Later, Möngke Khan raised him to the rank of General Commander (*Du Yuanshuai*). In 1253, he served under Hülegü in attacking tribes in parts of Tibet and the Hexi region and subjugated them all. After his death, his son succeeded him as an artillery commander.[103]

During the Mongol campaign against Khwarazm, catapults were commonly used against walled towns and fortresses.[104] At the siege of Nishapur in early 1222, the Mongol army reportedly set up as many as 200 catapults in a single day and battered the walls for three days until they were able to enter the city.[105] It is worth noticing that, when the Khwarazmian forces of Jalal Al-Din besieged Khelath in 1229, the siege lasted for a very long time and was only ended when some of those inside the city came to terms with the besiegers and assisted them in entering it.[106] Evidently, the siege techniques of the Mongol armies were greatly superior to those of the Khwarazmians, although the latter also used catapults.[107] It is interesting, too, that the catapults used at Nishapur were said to be "munis

[101] *YS*, xii, juan 151 [liezhuan 38], pp. 3563–3564.
[102] *YS*, i, juan 6 [benji 6], p. 118.
[103] *YS*, x, juan 122 [liezhuan 9], p. 3010.
[104] See, for example, Mohammed En-Nesawi, *Histoire du sultan Djelal Ed-Din Mankobirti, Prince du Kharezm*, trans. O. Houdas, (Paris, 1895), pp. 87, 154.
[105] *Ibid.*, p. 92.
[106] *Ibid.*, pp. 330–332.
[107] *Ibid.*, pp. 303, 308.

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de tous leurs engins [supplied with all their devices]".[108] This implies that they were not simply throwing stones, but probably also a range of incendiary, and perhaps explosive, bombs.

Clearly, the Mongols began to use Chinese artillery weaponry to good effect quite early in their campaigns. Not only did former military commanders and soldiers of the Jin Empire submit to them and join their ranks, at least as early as 1211, but some Mongols themselves learned to use at least some kinds of Chinese artillery. Chinggis Khan himself is recorded as understanding the value of catapults in assaulting walled towns. Chinese fire-weapons (probably using incendiary gunpowder) were used with reportedly decisive effect in the Mongol invasion of Khwarazm. It is very significant that fire-arrows fired by Chinese troops were used with great success in the battle on the Amu Darya, when the Khwarazm Shah's forces suffered a major defeat. This shows clearly that such weapons could be highly effective not only in siege warfare but also in open battle. That these weapons struck terror into the hearts of those to whom they were totally new and unfamiliar is strongly suggested, not only by the rapid surrender of the Assassins at Maimun-Diz, but also by John of Plano Carpini's tale of the use of human fat to make "almost inextinguishable" incendiary devices. The seemingly inexplicable gave rise to highly imaginative explanation.

After the defeat of the Khwarazm Shah, part of the Mongol forces had pursued him in his flight to an island in the Caspian Sea, where he soon died of illness. Rather than simply returning by the way that they had come, the commanders of this army, Jebe and Sübötei, decided to make a complete circuit of the Caspian, crossing the Caucasus range and approaching southern Russia before returning eastwards. They fought several battles, usually victoriously, but could not fully subjugate the lands through which they passed. During the late 1220s and early 1230s, the Mongols were fully occupied with the campaigns that finally destroyed first the Xi Xia kingdom and then the Jin Empire. Only in the later 1230s did they again turn their attention westwards. In December 1237, they took their first Russian town, Ryazan, in just five days. Then they advanced on Volodimir (Vladimir). They "approached the town and surrounded the town in force, and fenced it all round with a fence." Then they set up catapults "and took the town and fired it".[109] In fact, it is probable that the order of events here is not quite correct. The catapults no doubt fired incendiary bombs, as described by John of Plano Carpini, so that the town was set on fire *before* it was taken. The use of catapults firing incendiary bombs would explain why the Mongol armies were able to take so many walled Russian towns in the course of a single winter, from Ryazan to Moscow; more than a dozen in all. Russian towns at the period were largely built of wood, which was plentiful in the region. It is noticeable that the Russian chronicles of the time often stress the fact that a church was built of stone, undoubtedly because stone buildings were a rarity.[110] The Mongols campaigned during the cold Russian winter, when all water

[108] *Ibid.*, p. 92.

[109] R. Michell and N. Forbes, (trans.), *The Chronicle of Novgorod, 1016–1471*, (London, 1914), pp. 82–83. The translation here actually reads "set up battering-rams", but indicates uncertainty by giving in a foot-note the original Russian word thus translated, '*porok*'. It is now known that '*porok*' means 'catapults'. The word shows a clear resemblance to the Chinese word '*pao*' and it must be likely that it was derived from it, either directly or through a Turkic or Mongolian intermediate.

[110] e.g. *Ibid.*, pp. 43, 58, 66–67, 68.

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was frozen and everything was dry. Thus, the Russian towns burned, quickly and fiercely, and it was even difficult to get water to try to extinguish the flames. One Russian town, Torzhok, distinguished itself by managing to hold out against the Mongol forces and their catapults for as long as two weeks, but it was exceptional.[111] Novgorod was untouched during this campaign. Although the Russian sources do not explain exactly why, it is clear that this was probably because it submitted without a fight. This is suggested by the fact that, some years later, the Mongols took a census in Novgorod, an essential prerequisite to taxing the local population. Although the common people tried to resist this process, they were more or less forcibly persuaded to accept it by their rulers, with Aleksander Nevskii at their head.[112] A couple of years after beginning their campaign in Russia, as winter began in 1240, the Mongols resumed their advance. Early in December Kiev fell, after a siege of just nine days.[113] This was the greatest of Russian cities at the time and probably one of the largest cities in Europe. Archaeological evidence shows that, like other Russian settlements, it burned.[114]

Subsequently the Mongol armies advanced further into Europe by several different routes. One force entered Poland and reached one of the furthest points west to which any Mongol force ever advanced – Legnica in western Poland (at one time, Liegnitz in Germany). There they were confronted by a substantial force of Poles and Germans led by Prince Henry of Wroclaw (Breslau). On 9 April 1241 battle was joined. According to the account of this battle in a Polish chronicle, the Poles at first did well against the Mongols. "The Tatars attack fiercely, but the Poles refuse to retreat, and for a while honours are even", says the chronicle. But then the "Tatars" use "the arts of divination and witchcraft". A Mongol standard-bearer begins to wave his banner violently and from it "there suddenly bursts a cloud with a foul smell that envelopes the Poles and makes them all but faint, so that they are incapable of fighting". Then, "seeing that the all but victorious Poles are daunted by the cloud and its foul smell", the Mongols attack fiercely, "scattering the Polish ranks that hitherto have held firm, and a huge slaughter ensues".[115] Here again, the European chronicler, unable to understand the true source of the poisonous smoke, attributes it to witchcraft. However, it can safely be assumed that the Mongol forces simply used Chinese weaponry, which by this time had already existed for some two centuries. The poisonous smoke was either from bombs catapulted towards the ranks of the Poles or, perhaps more likely, projected from fire-lances. The latter weapons would have been more easily carried by a mobile force than catapults. Here again, as at the battle on the Amu Darya, it seems that Chinese weaponry was crucial in the Mongol victory. Interestingly, the well-informed Matthew Paris, although writing at a great distance, in England, records information from "Peter, a Russian archbishop", who also said that the Mongol armies used poisoned weaponry: "arma ... habent ... ferrea et

[111] *Ibid.*, p. 83.

[112] *Ibid.*, pp. 95–97; T. T. Allsen, "Mongol Census Taking in Rus", 1245–1275', *Harvard Ukrainian Studies*, 5(1) (1981), p. 43.

[113] Rashid Al-Din, *The Successors of Genghis Khan*, trans. J. A. Boyle, (New York and London, 1971), p. 69.

[114] D. Sinor, "The Mongols in the West", *Journal of Asian History*, 33(1) (1999), p. 90.

[115] J. Długosz, *The Annals of Jan Długosz*, (Chichester, 1997), p. 180 – excerpt available HTTP: http://www.impub.co.uk/dlug3.html (accessed 28 August 2008); J. Długosz, *Historia Polonica, Libri XII*, (Leipzig, Gleditsch and Weidmann, 1711), column 679.

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intoxicata [they have iron and poisoned weapons]". The same source also noted their use of catapults: "Machinas habent multiplices, recte et fortiter jacientes [they have numerous machines that throw straight and with force]".[116] This confirms the use of catapults in the Mongols' campaigns in Russia. This archbishop's account of the Mongols, which is quite long, appears to be generally quite accurate and reliable.

There has been considerable speculation in the past regarding whether the Mongols used guns or other gunpowder weapons, and whether they were instrumental in introducing gunpowder from China to the West. Until recently, evidence was insufficient to answer these questions with any degree of certainty. Some four decades ago, the question "Did the Mongols use guns?" could only be answered with "a qualified negative". It was considered "wholly improbable" that they could have introduced gunpowder and firearms to Europe.[117] However, it is now quite clear that the Mongol armies used a variety of Chinese artillery and fire weapons in their campaigns. Catapults, incendiary bombs, fire-lances and fire-arrows were commonly used in China by the early thirteenth century. A whole range of incendiary weapons, using gunpowder (or at least saltpetre) to produce fierce, "almost inextinguishable" flames, had existed in China since the early Northern Song period, about the year 1000. Explosive bombs had been in use since at least as early as about 1150, with cast iron casings from about 1220. There is archaeological proof that explosive bombs were taken to Japan during the Mongol invasions, and much literary evidence that the Mongols appreciated the usefulness of Chinese weaponry at an early date: Chinggis Khan himself is recorded as having at least some understanding of its value. Chinese troops from the Jin Empire joined the Mongols and fought alongside them in their earliest western campaigns. The success, speed and range of the Mongol conquests were not simply the result of efficient military organisation, excellent generalship and exceptionally effective use of traditional steppe nomad weapons. Cavalry armed with bows and arrows could not possibly have taken walled towns, cities and fortresses as easily and rapidly as the Mongol armies consistently did, during the early period of their conquests. The Mongol conquests were essentially enabled by Chinese artillery and Chinese gunpowder weapons. It could, in fact, plausibly be argued that the Mongol empire was the first of the so-called 'gunpowder empires'. As to whether the Mongols used guns, the evidence is that by the late 1200s they certainly did and it must at least be likely that they began to use them earlier. The use of guns, however, is not the essential issue. The range of Chinese gunpowder weapons available to the Mongols, such as explosive and incendiary bombs, fire-lances and fire-arrows, was sufficient to inspire terror in enemies who had never previously encountered anything of the kind. Since such weaponry was unknown in the West, it was not understood and its use by the Mongol armies was explained in terms of 'witchcraft'. However, by about 1250 the secret of gunpowder had become known to many of the Mongols' enemies. This must almost certainly have been a result of the use of Chinese weapons by the Mongol armies, which carried the Chinese technology of gunpowder weaponry westwards. By the 1260s, this knowledge had reached

[116]Matthew Paris, *Chronica majora*, edited by H. R. Luard, vol. IV, (London, Longman and Trübner, 1877), p. 388.

[117]J. J. Saunders, *The History of the Mongol Conquests*, (Philadelphia, 2001), p. 199.

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as far as England, where Roger Bacon recorded a gunpowder formula.[118] This probably explains why the Mongol conquests lost their impetus, at least in the West, after the 1250s. The fact that the Song Empire possessed gunpowder weapons even before the Mongols began their career of conquest certainly contributed to making the overthrow of Southern Song the longest and most hard-fought of all the Mongols' victorious campaigns.

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List of Chinese Characters:

Aju 阿术
Anmuhai 唵木海
Anlu 安陸

ba dou 芭豆
ba niu nu 八牛弩
bai wushi yu bu 百五十餘步
baozhang 爆仗
baozhu 爆竹
Bianjing 卞京
bu 步

cao wutou 草烏頭
chi 尺
Chongqing 重慶
cun 寸

Dazu 大足
De'an 德安
Dehai 德海
Deshan 德山
Ding Li 鼎澧
Dongting 洞庭
Du Yuanshuai [General Commander] 都元帥

Fangshan 房山
feng dai 風袋
feng shen 風神

Gansu 甘肅
Gaochang 高昌
Guo Baoyu 郭寶玉

Han jun 漢軍
Henan 河南
Hexi 河西
Hezhong 河中
hou ji 後集
hou lu 後録
Hubei 湖北
Huai [river] 淮
huo dian zhu jia tie jie tou 火點著甲鐵皆透
huojili 火蒺藜
huojian 火箭
huopao 火炮,火砲
huopaoyao 火砲藥
huoqiang 火槍,火鎗
huotong 火筒
huoyao 火藥
huoyao jili 火藥蒺藜

Ji'nan 濟南
Jining 濟寧
Jiankang 建康
Jin 金
jin [weight] 斤
Jinninglu 晋寧路
Juyong 居庸
juan 卷
juan shang 卷上
juan xia 卷下
juan zhong 卷中
Junsheng 軍勝

Kaifeng 開封

lang du 狼毒
li 里
Li Quan 李全
Li Tan 李璮

[118] *Ibid.*, p. 199; L. Lacabane, *De la poudre à canon et de son introduction en France*, (Paris, 1844), pp. 7–8. It should be noted that it was not necessarily the case that the Mongols' enemies learned how to make and use gunpowder weapons. Simply knowing what they were and how to counter them, as far as was possible, was enough to reduce their effectiveness, perhaps particularly their psychological effect.

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liezhuan 列傳
Linfen 臨汾

Ming 明
mu 畝

pao 砲
pao qi huo fa 砲起火發
pili huo qiu 霹靂火毬
pili pao 霹靂礮, 霹靂砲
pili huopao 霹靂火砲
Puzhou 蒲州

Qichun 蘄春
Qizhou 蘄州
qian ji 前集

Sanmenxia 三門峽
Shandong 山東
Shanxi 山西
Shanzhou 陝州
Shen Wei 神衛
sheng yuan wen 聲遠聞
Shi Tianze 史天澤
shou pao 手砲
shuijun 水軍
Song 宋
suo ruo wei ban mu zhi shang 所爇圍半畝之上

Tai Zong Shi Lu 太宗實錄
Taiyuan 太原
Tang Fu 唐福
Tang [dynasty] 唐
tie huo tong 鉄火桶
tie huo zhui 鉄火錐
Tongguan 潼関
tuhuoqiang 突火槍
tuhuotong 突火筒

wanhu 萬户
Wu De 武德
Wuwei 武威

Xi Xia 西夏
Xilinhot 錫林浩特
xia juan 下卷
Xiansigan 掾思干
Xiangyang 襄陽
Xiaojian Ju 硝城局
Xue Talahai 薛塔剌海

Yang Yao 楊么
Yuan 元

zhang 丈
Zhang Hui 張惠
zhen tian lei 震天雷
zhi 志
zhipao 紙砲
Zhong Xiang 鍾相
Zhongdu 中都
Zhu Yuanzhang 朱元璋
zike 子窠

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This bibliography is in two main sections, the first further subdivided into two. This first section includes all those works consulted that are written in Chinese. It gives the Chinese characters of names of authors and editors, titles and publishers. In accordance with common usage, pre-modern works (written in Classical Chinese) are listed separately from modern Chinese works. The former are cited in the references by abbreviations derived from their titles. The date given in parenthesis after the author's name is that of first completion of the text. The date of publication of the edition consulted is given at the end of the citation. In a number of cases, more than one edition of the same work has been consulted. This has been noted only when it seemed useful to do so. Names of Chinese authors of modern works in Chinese are cited in full in the references. Those writing in English are cited by initials and surname only. The second section of this bibliography lists works in European and other languages.

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